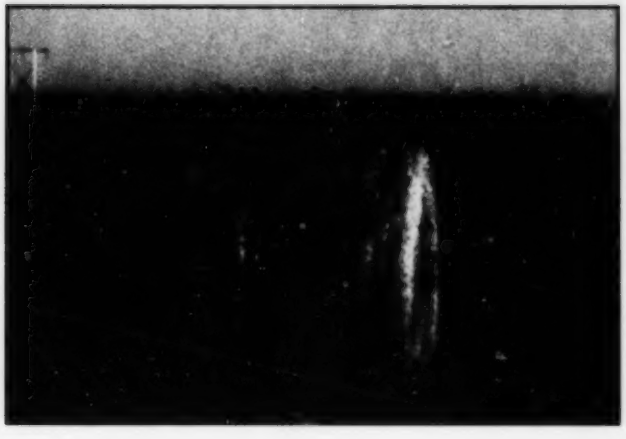
RE-GRASSING FARMLAND:
A PRACTICAL GUIDE TO SELECTING THE RIGHT FORAGE SPECIES



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FORWARD

A recent analysis indicated that 10% or 6 Million acres of Saskatchewan cropland are environmentally unsustainable. Physical limitations include salinity, topography, erodibility or poor soil quality (e.g. poor soil development). Those limitations result in annual crop yields that are too low to cover the cost of production, making them economically unsustainable. This has become even more critical with the increase in input costs, the changes in grain transportation policy and the frequently low grain prices. Furthermore, soil quality on such land continues to decline.

This publication provides information to help producers select the right perennial forage species that are adapted to their environmental conditions and are suited to their intended uses.

Based on past experiences of producers, seeding marginal forages has many potential benefits including:

(1) Arresting further decline in soil quality;
(2) Protecting soil from erosion;
(3) Enhancing soil quality (e.g. improve soil structure and organic matter content);
(4) Improving nutrient cycling and status through nitrogen fixing legumes and return of nutrients deposited in livestock urine and feces;
(5) Controlling soil salinity by reducing the amount of water moving into recharge areas;
(6) Providing an opportunity for a potentially more profitable and sustainable land use alternative;
(7) Providing additional forage resources which would result in relieving grazing pressures from the native prairie and existing pastures thus reducing input costs and increase livestock numbers;
(8) Enhancing livestock as a diversification option;
(9) Enhancing watershed characteristics and function;
(10) Enhancing wildlife habitat; and
(11) Reducing fossil fuel consumption and increase the amount of carbon sequestered in the soil, thus contributing to improving air quality without costly pollution control measures on coal-fired power generation plants.

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PART 1
AGRONOMIC NOTES

INTRODUCTION

* Establishing perennial forages is a major financial and time investment.

* To protect your investment and ensure the desired short and long-term benefits, three basic requirements must be met:

  (1) Selecting the right forage species and varieties;
  (2) Proper planning and implementation of the forage seeding; and
  (3) Proper management and maintenance of the forage stand.

* This part of the report provides and overview of above basic requirements.

SELCTING THE RIGHT FORAGE SPECIES

FACTORS TO CONSIDER

* Forage species vary in their characteristics and in their tolerance to various environmental conditions.
* Climate is the major factor shaping the general character of our soils, resulting in the formation of four basic Soil Zones: Brown, Dark Brown, Black and Gray Wooded.
* The Brown, Dark Brown and Black Soils are called Chernozemic because they were formed under a grassland vegetation.
* The Gray Wooded Soils formed under a forest (largely aspen) vegetation.
* The Gray Wooded Soils are more acidic and are lower in soil organic matter than the Chernozemic Soils.
* Soil moisture increases from Brown to Dark Brown, to Black to Gray Wooded Soil Zones.
* Within a soil zone, differences in soil characteristics occur as a result of such factors as topography, parent material, and drainage.
* Forage species and varieties differ in their suitability for the different uses.

STEPS TO FOLLOW

(1) Know your environment:
  - Determine the soil zone in which the land parcel is located (general map on next page.)
  - Find the characteristics of the soil from soil maps and reports (obtainable from the Saskatchewan Land Resource Centre, Saskatoon, (306) 975-4060). In particular, you need to know the texture, the level of salinity, and drainage.

(2) Examine the table entitled "Species Selection at a Glance" to find candidate grass and/or legume species that are adapted to your environmental conditions.

(3) Determine the intended use of the forage seeding. Forage uses include: hay, pasture, both hay & pasture, rrosion control, salinity control, short-term forage/annual crop rotation, and wildlife habitat.

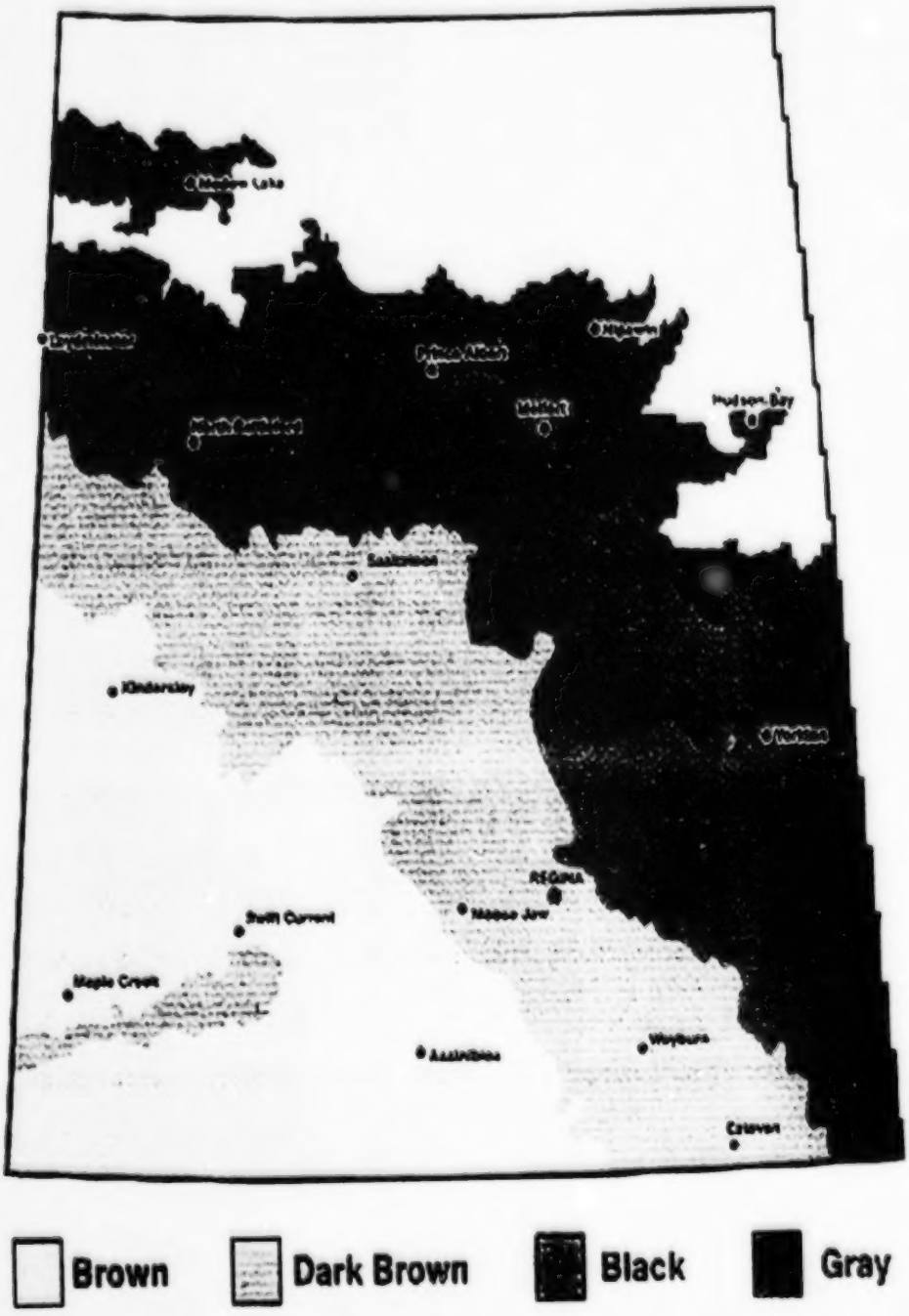
(4) Have a look at the information provided in the section entitled " Species Description" for each of the candidate species.

(5) Narrow down the selection to the species adapted to your specific environment and suited to your intended use(s).

(6) Select the variety that will fit your goals best.

(7) Seed cost and availability, particularly of native species, may affect the final decision.

Figure 1 Soil Zones of Saskatchewan



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SPECIES SELECTION AT A GLANCE

Tolerance or Adaptation to Soil, Grazing and Climatic Conditions - GRASSES

Species	Salinity	Flooding	Poor Drainage	Acidity	Alkalinity	Drought	Texture	Organic (peat)	Grazing Tolerance	Winter hardiness
[illegible]	Very good	Fair	Poor	Fair	Fair	Good	Loam, clay loam	Poor	Good	Very good
Russian wildrye	Good	Poor	Poor	Fair	Fair	Very good	Loam, clay loam	Poor	Good	Very good
[illegible]	Good	Poor	Poor	Fair	Good	Very good	Sandy to clayey	Poor	Very good	Very good
Intermediate wheatgrass	Fair	Fair	Poor	Fair	Fair	Fair	Loamy to Clayey	Poor	Fair-Good	Fair
[illegible]	Good	Fair	Poor	Fair	Good	Good		Poor	Good	Good
Slender wheatgrass	Very good	Good	Fair	Fair	Good	Good	Sandy loam to clayey	Poor	Good	Good
[illegible]	Very good	Good	Fair	Fair	Good	Very good	Loamy, clayey	Poor	Good	Very good
Northern wheatgrass	Good	Fair	Poor	Fair	Good	Very good	Sandy to clay loam	Poor	Good	Very good
[illegible]	Good	Good	Fair	Fair	Good	Very good	Loamy-clayey	Poor	Very good	Very good
Green needlegrass	Fair	Fair	Poor	Poor	Fair	Good	Loamy-clayey	Poor	Fair	Very good
[illegible]	Very good	Good	Very good	Poor	Good	Good	Loamy-clayey	Poor	Fair	Very good
Perennial ryegrass	Poor	Poor	Poor	Fair-good	Poor	Poor	Loamy-clayey	Poor	Fair-good	Poor
[illegible]	Fair	Poor	Poor	Fair	Fair	Good	Loamy-clayey	Poor	Good	Very good
Smooth bromegrass	Good	Fair	Fair	Fair-good	Fair	Good	Loamy-clayey	Poor	Very good	Very good

Tolerance or Adaptation to Soil, Grazing and Climatic Conditions - GRASSES

Species	Salinity	Flooding	Poor Drainage	Acidity	Alkalinity	Drought	Texture	Organic (peat)	Grazing Tolerance	Winter hardiness
Creeping red fescue	Poor	Fair	Fair	Good	Poor	Fair	Sandy to clayey	Poor	Very good	Very good
Meadow fescue	Poor	Fair	Fair	Fair	Poor	Poor	Clayey	Fair	Good	Poor
Tall fescue	Fair	Good	High	Good	Good	Poor	Loamy-clayey	Fair	Good	Poor
Meadow foxtail	Poor	Good	Fair	Good	Fair	Poor	Loamy-clayey	Good	Good	Very good
Creeping foxtail	Good	Very good	Good	Good	Good	Poor	Loamy-clayey	Good	Good	Very good
Orchard grass	Fair	Poor	Poor	Good	Poor	Poor	Loamy-clayey	Poor	Fair	Poor
Timothy	Poor	Very good	Very good	Good	Poor	Poor	Loamy-clayey	Very good	Poor	Fair
Reed canarygrass	Fair	Very good	Very good	Good	Poor	Poor	Loamy-clayey	Good	Good	Very good
Dahurian wildrye	Very good	Fair-good	Fair-good	Fair	Good	Good	Sandy to clayey	Poor	Good	Good

Tolerance or Adaptation to Soil, Grazing and Climatic Conditions - GRASSES

Species	Salinity	Flooding	Poor Drainage	Acidity	Alkalinity	Drought	Texture	Organic (peat)	Grazing Tolerance	Winter hardiness
Altai wildrye	**Very good**	**Fair**	**Poor**	**Fair**	**Fair**	**Good**	**Loam, clay loam**	**Poor**	**Good**	**Very good**
Russian wildrye	Good	Poor	Poor	Fair	Fair	Very good	Loam, clay loam	Poor	Good	Very good
Crested wheatgrass	**Good**	**Poor**	**Poor**	**Fair**	**Good**	**Very good**	**Sandy to clayey**	**Poor**	**Very good**	**Very good**
Intermediate wheatgrass	Fair	Fair	Poor	Fair	Fair	Fair	Loamy to Clayey	Poor	Fair-Good	Fair
Pubescent Wheatgrass	**Good**	**Fair**	**Poor**	**Fair**	**Good**	**Good**		**Poor**	**Good**	**Good**
Slender wheatgrass	Very good	Good	Fair	Fair	Good	Good	Sandy loam to clayey	Poor	Good	Good
Western wheatgrass	**Very good**	**Good**	**Fair**	**Fair**	**Good**	**Very good**	**Loamy, clayey**	**Poor**	**Good**	**Very good**
Northern wheatgrass	Good	Fair	Poor	Fair	Good	Very good	Sandy to clay loam	Poor	Good	Very good
Stream-bank wheatgrass	**Good**	**Good**	**Fair**	**Fair**	**Good**	**Very good**	**Loamy-clayey**	**Poor**	**Very good**	**Very good**
Green needlegrass	Fair	Fair	Poor	Poor	Fair	Good	Loamy-clayey	Poor	Fair	Very good
Tall wheatgrass	**Very good**	**Good**	**Very good**	**Poor**	**Good**	**Good**	**Loamy-clayey**	**Poor**	**Fair**	**Very good**
Perennial ryegrass	Poor	Poor	Poor	Fair-good	Poor	Poor	Loamy-clayey	Poor	Fair-good	Poor
Meadow bromegrass	**Fair**	**Poor**	**Poor**	**Fair**	**Fair**	**Good**	**Loamy-clayey**	**Poor**	**Good**	**Very good**
Smooth bromegrass	Good	Fair	Fair	Fair-good	Fair	Good	Loamy-clayey	Poor	Very good	Very good

Tolerance or Adaptation to Soil, Grazing and Climatic Conditions - GRASSES

Species	Salinity	Flooding	Poor Drainage	Acidity	Alkalinity	Drought	Texture	Organic (peat)	Grazing Tolerance	Winter hardiness
Creeping red fescue	Poor	Fair	Fair	Good	Poor	Fair	Sandy to clayey	Poor	Very good	Very good
Meadow fescue	Poor	Fair	Fair	Fair	Poor	Poor	Clayey	Fair	Good	Poor
Tall fescue	Fair	Good	High	Good	Good	Poor	Loamy-clayey	Fair	Good	Poor
Meadow foxtail	Poor	Good	Fair	Good	Fair	Poor	Loamy-clayey	Good	Good	Very good
Creeping foxtail	Good	Very good	Good	Good	Good	Poor	Loamy-clayey	Good	Good	Very good
Orchard grass	Fair	Poor	Poor	Good	Poor	Poor	Loamy-clayey	Poor	Fair	Poor
Timothy	Poor	Very good	Very good	Good	Poor	Poor	Loamy-clayey	Very good	Poor	Fair
Reed canarygrass	Fair	Very good	Very good	Good	Poor	Poor	Loamy-clayey	Good	Good	Very good
Dahurian wildrye	Very good	Fair-good	Fair-good	Fair	Good	Good	Sandy to clayey	Poor	Good	Good

Tolerance or Adaptation to Soil, Grazing and Climatic Conditions - LEGUMES										
Species	**Salinity**	**Flooding**	**Poor Drainage**	**Acidity**	**Alkalinity**	**Drought**	**Texture**	**Organic (peat)**	**Grazing Tolerance**	**Cold Tolerance**
Alfalfa - Creeping rooted	Good	Poor	Poor	Fair	Good	Very good	Wide texture	Poor	Very good	Good
Alfalfa - Tap rooted	**Fair**	**Poor**	**Poor**	**Fair**	**Good**	**Good**	**Wide texture**	**Poor**	**Good**	**Fair-good**
Alsike Clover	Poor	Very good	Very good	Good	Fair	Poor				
Red Clover	**Poor**	**Fair**	**Poor**	**Very good**	**Poor**	**Poor**		**Good**		
White Clover	Poor	Poor	Poor	Fair	Poor	Poor	Loamy to clayey		Fair-good	Fair-good
Bird's Foot Trefoil	**Poor**	**Good**	**Good**	**Good**	**Good**	**Poor**	**Sandy loam to clayey**	**Good**	**Fair-good**	**Fair**
Sainfoin	Fair	Poor	Poor	Fair	Good	Good	Wide texture	Poor	Good	Fair-good
Cicer Milkvetch	**Fair-good**	**Poor**	**Poor**	**Fair**	**Good**	**Good**	**Wide texture**	**Poor**	**Very good**	**Good**
S. Clover	Good	Poor	Poor	Fair	Good	Good	Wide texture	Poor	Good	Good

Tolerance or Adaptation to Soil, Grazing and Climatic Conditions - LEGUMES

Alfalfa - Creeping rooted	Good	Poor	Poor	Fair	Good	Very good	Wide texture	Poor	Very good	Good
Alsike Clover	Poor	Very good	Very good	Good	Fair	Poor				
White Clover	Poor	Poor	Poor	Fair	Poor	Poor	Loamy to clayey		Fair-good	Fair-good
Sainfoin	Fair	Poor	Poor	Fair	Good	Good	Wide texture	Poor	Good	Fair-good
S. Clover	Good	Poor	Poor	Fair	Good	Good	Wide texture	Poor	Good	Good

PLANNING AND IMPLEMENTATION OF FORAGE SEEDINGS

SEEDBED CONDITION

The following tips are important for establishing a successful forage stand:

* A firm seedbed is required. A foot-print should not sink into the soil more than 1/4". The firm seedbed allows for better control of seeding depth, reduces surface drying and result in better seed-soil contact.
* **Seedbed should be free of perennial weeds.**
* Seeding in clean stubble allows good depth control.
* Annual crop stubble creates a favourable microclimate and protects seedlings against soil erosion.
* Avoid excessive crop residues.
* Tilled fields should be packed prior to seeding.
* Seed in moist soils, if possible.
* Ensure cropland is free of herbicide residue that may affect grass or legume establishment (refer to the Saskatchewan Crop Protection Guide.)

SEEDING METHODS

* See publication entitled "Seeding equipment for forages" for detail.
* Any seeding method or equipment is acceptable as long as seeding depth is kept around 1-2 cm (0.5-0.75 ") and the soil is packed following seeding.
* Seeding depth may be increased slightly in the case of sandy and saline soils.
* If using a double-disc drill, a depth control band may be necessary, or else reduce the pressure of the drills.
* Seed-box equipped with a seed agitator prevents the fluffy seed from bridging and ensure more uniform flow.
* Air seeders can be used for seeding forages if properly modified. See publication entitled: "Air-Seeding Forage Crops."

Broadcast seeding may be used on tilled soils (ensure firmness). The land should then be harrow-packed or rolled to cover the seed and ensure seed-soil contact.

* Seeding method affects seeding rate (see section on seeding rates.)

COVER CROPS

* Cover crops can reduce establishment and future yield of perennial forages due to the competition for soil moisture, nutrients and light.
* The competition is particularly severe in the Brown and Dark Brown Soil Zones and in dry years.
* Cover crops provide a yield in the year of establishment and can help reduce wind and water erosion and severity of weed infestation.
* The competition from the cover crop can be minimized by employing the following recommendations:
  (1) Seed the cover crop at only 1/3 to 1/2 the regular crop seeding rates.
  (2) Seed the cover crop in alternate rows or cross-rows with the forage species.
  (3) Seed the less competitive crops (for example, flax and oats are less competitive than barley.)
  (4) Select the early maturing crops and varieties.
* Cut the crop and remove early for greenfeed or silage.

SEEDING RATES

* Seeding rates depend on **seed size**, **seed quality**, seeding **method** and **row spacing**.
* Forage seeds are mostly small in size and often of light weight.
* Seed quality is determined by the number of pure live seeds (PLS).
* PLS can be calculated from the certificate of analysis supplied by the seed dealer.
* A seeding rate of 20-30 seeds per linear foot of row is often used as a rough guide for most forage species. Generally smaller seeded species, such as Timothy, require more seeds per foot than the larger seeded species like meadow bromegrass.
* If broadcast seeding (see seeding methods), increase seeding rate by 40-50%.
* Table 1 provides the basis for calculating seeding rates.

Table 1. Seeding rates for pure stands of grasses and legumes*.

Forage species	Number of seeds		Seeding Rate (lb/acre or kg/ha)	
	Seeds/lb	Seeds/kg	9" Row spacing	12" Row Spacing
GRASSES				
Altai wildrye grass	55,000	121,000		12
Creeping foxtail	753,000	1,657,000	4	3
Creeping red fescue	615,000	1,353,000	5	4
Crested wheatgrass - Diploid (Fairway)	220,000	485,000	5-6	4
Crested Wheatgrass - Tetraploid (Standard)	175,000	385,000	6-7	6
Dahurian wildrye grass	85,000	187,000	11	9
Intermediate wheatgrass	88,000	194,000	12	6
Meadow bromegrass	75,000	165,000	9-10	8
Meadow foxtail	575,000	1,270,000	6	4
Northern wheatgrass	155,000	340,000	7	5
Pubescent wheatgrass	100,000	220,000	11	8
Orchard grass	650,000	1,439,000	5	4
Perennial ryegrass	227,000	500,000	8	6
Reed canarygrass	525,000	1,175,000	5	4
Russian wildrye grass - Tetracan	100,000	220,000	10	7
Russian wildrye grass - Others	175,000	385,000	7	5
Slender wheatgrass	160,000	350,000	7	5
Smooth bromegrass	136,000	300,000	6-8	5
Streambank wheatgrass	155,000	344,000	7	5
Tall fescue	225,000	500,000	8	5
Tall wheatgrass	79,000	174,000	12	9
Timothy	1,230,000	2,710,00	4	2
Western wheatgrass	110,000	242,000	9	6
LEGUMES				
Alfalfa	200,000	440,000	8	5
Alsike clover	700,000	1,540,000	4	
Birdsfoot trefoil	375,000	825,000	6	
Cicer milkvetch	130,000	286,000	10	8
Red clover	275,000	605,000	5	
Sainfoin	30,000	66,000	28	22
Sweet clover	260,000	572,000	9	6
White clover	800,000	1,760,000	5	

- Modified from the 1999 Saskatchewan Forage Crop Recommendations, Alberta Agdex 120/22-2 (1994) and Forage Establishment (Ducks Unlimited et al, 1990).
- There are 43560 ft² per acre.
- Increase rate by about 40-50% if broadcasting.
- If site is saline use salt tolerant species at a rate 40% higher than above.
- ***Pre-inoculated legume seeds are widely available.***

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Birdsfoot trefoil	375,000	825,000	6	
Cicer milkvetch	150,000	330,000	10	8
Red clover	275,000	605,000	5	
Sainfoin	30,000	66,000	28	22
Sweet clover	260,000	572,000	9	6
White clover	600,000	1,320,000	3	

- Modified from the 1999 Saskatchewan Forage Crop Recommendations, Alberta Agdex 120/22-2 (1994) and Forage Establishment (Ducks Unlimited et al, 1990).
- There are 43560 ft^2 per acre.
- Increase rate by about 40-50% if broadcasting.
- If site is saline use salt tolerant species at a rate 40% higher than above.
- ***Pre-inoculated legume seeds are widely available.***

ROW SPACING

* Row spacing depends on the soil zone (moisture regime) and intended use:

	Brown Soils	Dark Brown Soils	Black & Gray Soils
Pasture	18"	12"	9-12"
Hay	18-24"	18"	12"

* Wider row spacing would be required for seed production.
* Legume seeds must be inoculated using the appropriate rhizobium strain and method of application.

SEEDING MIXTURES

* Simple mixtures consisting of a legume and a grass are generally recommended.
* More complex mixtures are not easy to manage or maintain, particularly under grazing.
* Use species with similar palatability and season of growth.
* To take advantage of species varying in season of growth, seed them in separate fields.
* In heterogeneous environments, like saline soils, a more complex mixture is justified.
* A fast growing, short-lived grass, like Dahurian wildrye grass, may be used in a mixture with slow developing, long-lived grasses. Note the discussion on competition in the Cover Crop Section.
* Sainfoin may be used in a mixture with alfalfa to reduce the incidence of bloat.
* Seed grass in alternate or cross rows with legumes to reduce competition.
* Seeding alfalfa in the same row with the grass may reduce the incidence of bloat.

SEEDING DATES

* Spring is the preferred time for seeding forages due to the greater probability of good soil moisture conditions.
* Delayed seeding will often reduce establishment and vigor, particularly in the Brown and Dark Brown Soil Zones.
* There may be an opportunity for seeding in early August in the moist Black Soil Zone. Moisture must be sufficient for grass to develop sufficiently for winter survival.
* ***Dormant season seeding can be successful with grasses. It is particularly useful in the Brown and Dark Brown Soil Zones. Seed in late fall just before freeze up. Germination is to take place in spring, taking advantage of the usually favorable soil moisture.***

FORAGE - ANNUAL CROP ROTATIONS

Including a legume in a short rotation with annual crops can have many environmental benefits:

(1) Improving water holding capacity of the soil.
(2) Increasing soil organic matter.
(3) Reducing soil pathogens.
(4) Increasing soil nitrogen levels.
(5) Reducing water seep, the main cause of salinity in discharge areas.

MANAGEMENT AND MAINTENANCE

* In general, grazing or haying should not be carried out during the establishment year, particularly in the Brown and Dark Brown Soil Zones.
* In the establishment year, cut and remove weeds before they produce seed.
* Consider spray for broadleaf control in pure grass stands, if necessary (see 1999 Saskatchewan Crop Protection Recommendations.)
* Stock conservatively and monitor to maintain an adequate stubble height and residue (see publications: Initial Stocking Rate Recommendations for Seeded Forages in Saskatchewan; and Planning Aids for Balancing Forage Supply and Demand.)
* Consider fertilizing the stand to maintain productivity (see publication: Fertilizing Tame Pastures in Saskatchewan.)
* Monitor plant vigor and invasion of less desirable species.
* Consider employing a grazing system that suits your forage type, goals, finances and available labor (see publication: Grazing Systems for Southern Saskatchewan.)
* Review the notes specific to each species in the Species Description Section (Part 2.)

PART 2

SPECIES DESCRIPTIONS

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GRASSES

SMOOTH BROMEGRASS

Description

* Long-lived, sod-forming, perennial grass.
* Develops aggressive rhizomes and extensive root system.
* Leaves are distributed more or less uniformly along the stem.
* There are three types: Northern, Southern and Intermediate types.
* The Northern type is the most leafy and has the most open sod with the least aggressive rhizomes.
* May invade moist native prairies, particularly disturbed areas in the Fescue Prairie and riparian areas.

Smooth bromegrass

Adaptation

* Adapted to the Dark Brown, Black and Gray Soil Zones, but is commonly used also in the moist areas in the Brown Soil Zone.
* Grows in wide range of soils but does best on well-drained, medium to heavy-textured soils.
* Fairly drought tolerant.
* The Northern Type is the most winter hardy.
* Tolerates mild acidity and alkalinity.
* Tolerates mild to moderate salinity.
* Tolerates about 2-4 weeks of spring flooding.
* Sensitive to water-logged soil conditions.

Hay

* Well suited for hay production due to its upright growth and leaf distribution pattern along the stem.
* High yielding in pure stands or mixtures.
* Good nutritive value that is generally comparable with other grasses at the same stage of maturity.
* Productivity of the older stands decline due to the increased plant density and reduced fertility.
* Responds very well to nitrogen fertilization.
* Competes strongly with legumes and other forages in the mixture.
* Regrowth after cutting is slow.

Not recommended for short crop-forage rotation as it is not easy to eradicate.

Pasture

* Tolerates grazing very well.
* Palatability is high in the leafy stage but declines quickly after heading.
* Sensitive to close spring grazing as it needs to accumulate energy reserves for subsequent growth.
* Most growth takes place in the spring and early summer with a long mid and late summer slump in growth.
* Northern type starts growing earlier in the spring than the other types.
* Regrowth after grazing is slow.

Cultivar Notes

* The Northern (such as Carlton and Bravo) and Intermediate (such as Magna and Signal) types are late maturing and are less aggressive with alfalfa. The Southern type (like Baylor) is early maturing, forms dense sod quickly and is the least winter hardy.

Establishment Notes
* Relatively easy to establish.
* Stand development is relatively slow, reaching maximum yield in the second or third year.
* The Northern type is slower to establish.

Management Notes
* Leave an average of 3-4" (8-10 cm) stubble after grazing.
* Close grazing in the spring delays regrowth.
* The vigorous rhizomes makes the stand difficult to eradicate.
* Stand productivity declines considerably without fertilization.

MEADOW BROMEGRASS

Description
* Long-lived, bunch-like, perennial grass.
* Has no or short rhizomes.
* Produces plenty of long basal leaves with short hairs.

Meadow bromegrass

Adaptation
* Adapted to the Dark Brown, Black, and Gray Soil Zones, but many producers in the moist parts of the Brown Soil Zone have established successful and productive stands on good soils.
* Grows well on variety of soils but does best on moist, well-drained, medium-textured soils in the Black Soil Zone.
* Less winter hardy than smooth brome grass and crested wheatgrass.
* Moderately tolerant to drought.
* Tolerates less than 10 days of spring flooding.
* Sensitive to water-logged soil conditions.
* Less tolerant to salinity than smooth bromegrass.
* Tolerates mild alkalinity.
* Tolerates mild acidity.

Hay
* Less hay production than smooth bromegrass, as most of the production comes from basal leaves.
* Sets seed and matures 7-10 days earlier than smooth bromegrass.
* Usually only one cutting is possible.
* Leaves tend to droop, increasing losses during cutting and hay handling.
* Some producers in the Black and Gray Soil Zones cut it for hay and then utilize regrowth for grazing in late summer or fall.

Pasture
* Excellent pasture grass with abundant, palatable leaves.
* Starts growing early in the spring, nearly as early as crested wheatgrass in the Black Soil Zone.
* Becomes ready for grazing 7-10 days before smooth bromegrass.
* Nutritive value is slightly lower than that of smooth bromegrass.
* Mixes well with alfalfa, allowing alfalfa to last longer in the stand than in a smooth bromegrass mixture.
* Greater ability for regrowth after grazing than smooth bromegrass under adequate soil moisture conditions.
* Responds well to time-controlled grazing.
* Greener in the fall than smooth bromegrass.
* Sheep prefer smooth bromegrass over meadow bromegrass.
* Stand productivity does not decline with time as rapidly as the strongly sod-forming smooth bromegrass.

Cultivar Notes
* Regar, an older U.S. cultivar, is still available in Canada.
* Fleet and Paddock are the newest Canadian varieties and may yield better in moist areas.
* A smooth bromegrass X meadow bromegrass hybrid is being presently evaluated. This will incorporate the desirable qualities of the two species.

Establishment Notes
* Ease of establishment is virtually the same as smooth bromegrass.
* Seed is bigger than that of smooth bromegrass, so seeding rate is much higher (8-10 lb/acre in a pure stand).
* Seed is fluffy causing it to bridge in seed box. An agitator is needed to maintain consistent flow.
* Do not use a companion crop, substantial reduction in vigor can occur in the year following seeding.

Management Notes
* Allow for 8-12 A (20-30 cm) of growth before grazing.
* A minimum rest (regrowth) period of 4-weeks is necessary during the growing season for maximum productivity and longevity of the stand.
* Animals should be removed when there is still an average of 3.5-4" (8-10 cm) stubble remaining on the plant.
* About 6" (15 cm) of regrowth should be allowed in the fall to build up energy reserves that will provide early growth in the next spring and allow snow trapping.
* Responds well to nitrogen fertilization.

RUSSIAN WILDRYE GRASS

Description
* Long-lived, perennial, bunch grass.
* Develops extensive fibrous root system.
* Leaves are largely basal.

Adaptation
* Adapted primarily to the Brown, Dark Brown and Black Soil Zones.
* Very drought tolerant.
* Winter hardy.
* Performs best on loamy to clayey soils.
* Moderately tolerant to salinity.
* Moderately tolerant to alkalinity.
* Sensitive to acidity.

Hay
* Not well suited for hay as leaves are mostly basal.
* High protein content but yield is not particularly high.
* Fields are rough, particularly if wide-row spacing is used.

Pasture
* Good pasture from early spring to late fall.
* Highly palatable.
* Good curing quality for late summer and fall grazing, or even early winter.
* Some producers associate the incidence of pinkeye with grazing on mature Russian wildrye grass.

Russian wildrye grass

Cultivar Notes
* Swift is the available Diploid type. Tetracan is a Tetraploid type selected for easier establishment and development. However, this advantage has not been that apparent in the field.

Establishment Notes
* Difficult to establish as seedlings develop slowly.
* Will persist once established.
* If using the cultivar Tetracan, increase seeding rate by 75%, due to the difference in seed size.
* A companion crop is not recommended, but rapid growing, short-lived grasses can be seeded in alternate rows.
* Seed in alternate or cross rows with legumes because of its high competitive ability.

Management Notes
* Can be grazed to 3-4" stubble.
* Seed head formation can be reduced by grazing to about 3" stubble (8 cm) by June 1, the leafy regrowth can then be grazed in the fall.
* Requires nitrogen fertilization to maintain vigor and productivity.
* Seeded at very high rates to produce low-maintenance lawns.

ALTAI WILDRYE GRASS

Description
* Long-lived, perennial grass.
* Deep root system and short rhizomes.
* Larger and more robust than Russian wildrye grass.

Adaptation
* Adapted to the Brown, Dark Brown and Gray Soil Zones.
* Does best on loamy to clayey soils.
* Winter hardy.
* Good tolerance to salinity and alkalinity.
* Drought tolerant as root system is capable of using soil moisture at greater depth (about 10 ft) than most grasses.
* Tolerates about 4 weeks of spring flooding.

Hay
* Fair quality hay.
* Tends to form large clumps, particularly with wide row spacing.

Pasture
* Starts growing later in the spring than Russian wildrye grass.
* Cures well in the field and retains most of nutritive value throughout the summer and early fall.
* Particularly useful for fall and winter because of its quality, size, erect culms and long, rigid leaves that tend to bridge the snow.
* Fair palatability compared to many of the other forage species, particularly legumes. Palatability is improved after frost.

Cultivar Notes
* Prairieland, Eejay and Pearl. Pearl is somewhat lower yielding that the other two cultivars.

Establishment Notes
* Difficult to establish and slow to develop.
* Does not compete well with weeds in new stands.
* Much higher seeding rates than Russian wildrye grass due to its bigger seed (11 lb/acre in pure stands).

Management Notes
* Can be stockpiled for later fall/winter grazing.
* Difficult to manage in mixtures with more palatable species, particularly alfalfa, during the growing season.
* Leave 6-8" stubble to maintain a healthy stand.

Altai wildrye

DAHURIAN WILDRYE GRASS

Description
* Short-lived, perennial bunch grass.
* Develops a shallow root system.

Adaptation
* Adapted to Brown, Dark Brown, Black and Gray Soil Zones.
* Persists for 2-3 years in the south and 2-5 years in the north.
* Does best on heavier textured soils, but can be grown on coarser-textured soils.
* Winter hardy.
* Drought tolerant.
* Similar salt tolerance to Russian wildrye grass.
* Moderately tolerant to flooding (about 4 weeks) and poor drainage.

Hay
* Higher yield in the establishment year than crested wheatgrass and intermediate wheatgrass.
* Responds well to nitrogen fertilization.
* Quality similar to crested wheatgrass and intermediate wheatgrass, but declines less rapidly than crested wheatgrass.
* Palatability is low if cut at mature stage.

Pasture
* Starts growing early in the spring.
* Should be grazed before it gets too mature and stemmy.
* Rapid regrowth after grazing when moisture is adequate.

Cultivar Notes
* James and Arthur are the available cultivars in Saskatchewan. Arthur may produce more in the Brown Soil Zone.

Establishment Notes
* Easy to establish, good seedling vigour.
* Much higher seeding rates than Russian wildrye grass due to its bigger seed (11 lb/acre in pure stands).
* Seed in alternate or cross rows with legumes due to its competitiveness.
* No companion crop is necessary or needed. If growing season conditions are adequate, first-year yield is often higher than the other perennial forage species.
* Recommended in mixtures to provide forage while the slow-growing, longer-lived perennial species, such as Russian wildrye, are becoming established.

Management Notes
* Can be used in short grain-forage rotation or seeded in mixtures with slow developing grasses.
* Easy to eradicate from the stand.

CRESTED WHEATGRASS

Description
* Long-lived, perennial bunch grass.
* Develops extensive and deep root system.
* Two main types: the Fairway (Diploid) and the Standard (Tetraploid) Types.
* The Fairway type is shorter, more leafy and has less clumping tendency.
* May encroach into the native prairie, particularly in disturbed areas.

Crested wheatgrass

Adaptation

* Adapted to the Brown, Dark Brown, Black and Gray Soil zones; the Fairway Type persists longer in the moist areas (i.e. the Black and Gray Soil Zone).
* Does well on soils ranging in texture from sandy to clayey.
* Very winter hardy.
* Very drought tolerant; particularly the Standard Type.
* Tolerates moderate salinity.
* Tolerates moderate alkalinity.
* Intolerant to acidity.
* Tolerates only 7-10 days of spring flooding.
* Intolerant to water-logged soil conditions.

Hay

* Earliest maturing wheatgrass.
* High yield in the first 4-5 years, then production declines, mainly due to reduced nitrogen levels.
* Hay quality declines rapidly after heading.
* Pure stands respond well to nitrogen fertilization.

Pasture

* Considered excellent spring and early summer pasture due to its early and nutritious growth.
* Mixes well initially with alfalfa and other legumes, but, depending on management, may eliminate alfalfa after a few years due to its high competitiveness.
* Palatability and nutritive value drop quicker after heading than most other perennial grasses.
* Tolerates grazing very well.
* Often exhibits a long mid to late-summer slump in growth, particularly during hot dry periods.
* Excellent grass for complementary use with native prairie.

Cultivar Notes

* Fairway (diploid) type (Fairway and Parkway) are well suited for pasture and

are more persistent in the northern regions (Black and Gray soils).

* The standard (Tetraploid) type (such as Nordan) is well suited for hay and is well adapted for use in the Brown and Dark Brown Soil zones. Kirk, a relatively new Tetraploid cultivar, can be used for hay or pasture in the different soil zones.
* Mixtures of the standard type with bromegrasses can be difficult to utilize evenly.

Establishment

* Has excellent seedling vigor and is easy to establish.
* Will quickly fill in between rows if row spacing is wide and much seed production is allowed (can become too dense and less productive).
* Cross seeding with legumes will reduce the effect of crested wheatgrass competitiveness.

Management Notes

* Grazing management should minimize wolfplant (a stemmy plant that is usually avoided by the grazing animal) population by manipulating such factors as stocking density and grazing dates during the spring and early summer.
* Can be grazed to an average stubble height of 2-3".

INTERMEDIATE WHEATGRASS

Description

* Bunch-like, perennial grass with moderately creeping rhizomes.
* There are two types: Intermediate and Pubescent.

Intermediate wheatgrass

* The Pubescent type (sub-species) exhibits a greater sod-forming habit.
* Considered as a short-lived grass (4-5 years), but can persist longer under good management (such as one-cut hay systems) and good soil conditions.
* The Pubescent type is longer-lived.
* Adds more fiber to the soil than other grasses.

Adaptation
* Adapted to the Dark Brown, Black and Gray Soil Zones and the moist (14" average annual precipitation) areas of the Brown Soil Zone.
* Winter hardy.
* Drought tolerant, particularly the pubescent type.
* Tolerates moderate salinity.
* Tolerates slight acidity and mild alkalinity (Pubescent type tolerates moderate alkalinity).
* Does not tolerate spring flooding or saturated soils.

Hay
* In many areas the yield is similar to crested wheatgrass but somewhat greater than that of smooth bromegrass in high rainfall areas.
* Good quality hay in mixture with alfalfa as it is slower maturing than other grasses.
* Less competitive with alfalfa than smooth bromegrass or crested wheatgrass, allowing a more desirable legume-grass balance.
* Mixed stands do not lodge easily.
* Pure stands often require fertilization.
* Cutting height should be kept above 4" (10 cm).
* Cutting at the shot blade stage around mid June should be avoided, as it will lower the yield substantially.
* Can become overly stemmy if cut late.

Pasture
* Palatable to all classes of livestock.
* Most growth takes place in the spring and early summer but provides good spring to late summer grazing.
* Regrowth is better than smooth bromegrass.
* Retains nutritive quality relatively well after frost in the fall.

Cultivar Notes
* The Pubescent type (Greenleaf cultivar) is more adapted to the Brown and Dark Brown Soil zones than the Intermediate type (Chief and Clarke).

Establishment Notes
* Good seedling vigor, easy to establish.
* Seed in alternate or cross rows with legumes to improve total yield.
* Remains in the rosette stage in its first year.

Management Notes
* Sensitive to close grazing, particularly in the early stage of development.
* A minimum rest (regrowth) period of 6 weeks is required during the growing season.
* Leave a stubble of about 4" after grazing.
* Responds more to nitrogen fertilization than most grasses.

SLENDER WHEATGRASS

Description
* Native bunch grass.
* Short-lived (3-4 years) but may reseed itself.
* Commonly used in reclamation and wildlife habitat restoration.

Slender wheatgrass

Adaptation
* Moist Brown (minimum of 14" of average annual precipitation), Dark Brown and Black soils.
* Wide variety of soil textures but does best on sandy loam.
* Less drought tolerant than crested, western, and northern wheatgrasses.
* Tolerates strong salinity.
* Tolerates strong alkalinity.
* Tolerates mild acidity.
* Moderately tolerant to poor internal drainage.
* Tolerates spring flooding (till about 5 weeks).

Hay
* Good quality hay if cut soon after heading.
* Remarkably high forage production in first 2-3 years, after which it declines rapidly.
* Well suited for short grain-forage rotation.

Pasture
* Used in a mixture with slow developing, long-lived grasses.
* Relatively high nutritive value, but low palatability late in the season.

Cultivar Notes
* Revenue was the first Canadian variety. It was developed from a single plant from near Revenue, Saskatchewan. Revenue is more prone to head smut.
* Adanac: A newer Canadian variety, seed and forage yield is greater than Revenue. More salt tolerant than Revenue.

Establishment Notes
* Easy to establish and quick to develop.

Management Notes
* Well suited for short, grain-forage rotations, reclamation seeding and mixtures for saline areas.

WESTERN WHEATGRASS

Description
* Long-lived, native perennial grass.
* Sod-forming growth habit.
* Deep roots and extensive rhizomes.
* Slow to develop from seeds, but aggressive vegetative reproduction by its rhizomes thickens the stand.
* One of the most common species in the mixed prairie ecoregion.

Western wheatgrass

Adaptation
* Drought tolerant.
* Winter hardy.
* Adapted primarily to the Brown and Dark Brown Soil Zones.
* Can grow on soils with wide variety of textures, but performs best on clayey and clay loamy soils and well-drained bottomland.
* Tolerates strong salinity.
* Tolerates spring flooding well (about 5 weeks).
* Moderately tolerant to poor internal drainage.
* Tolerates strong alkalinity.
* Sensitive to acidity.

Hay
* Produces excellent quality hay.
* Yield is generally lower than tame forage species on normal upland soils.
* Nitrogen fertilization is required to maintain high level of productivity.

Pasture
* Nutritious and palatable forage.
* Excellent spring-summer grazing.
* Cures well on stem with potential for fall and winter grazing.
* Tolerates grazing very well.
* Responds well to time controlled grazing.

Cultivar Notes
* Walsh was developed from numerous collections from Saskatchewan and Alberta.
* Walsh is well suited to heavy textured soils and saline sites.
* Rosanna, a U.S. cultivar, has lower palatability.
* Ecovars (ecological varieties) are presently being developed.

Establishment Notes
* Seed at a depth of 1/2-1" (1.3-2.5 cm).
* Slow to establish due to seed dormancy and relatively low seedling vigor.
* Once established, its density increases rapidly through an extensive network of rhizomes.

Management Notes
* Leave a 3" stubble after grazing.
* Excellent for soil erosion control and reclamation.
* Used extensively in reclamation and wildlife habitat restoration.
* Appears to be good competitors with perennial weeds, e.g. leafy spurge.
* Deferred grazing is recommended.

STREAMBANK WHEATGRASS

Description
* Long-lived, sod-forming, native perennial grass.
* Develops extensive root system and aggressive rhizomes.

Adaptation
* Adapted to Brown, Dark Brown and Black Soil Zones.
* Drought tolerant.
* Tolerates moderate salinity and alkalinity.
* Sensitive to acidity.
* Tolerates some spring flooding (3-4 weeks.)
* Fair to moderate tolerance to poor drainage.

Hay
* Difficult to mow due to the coarseness of leaves.
* Lower forage yield than the other wheatgrasses.
* Nutritive value is fair but palatability is relatively low.

Pasture
* Not a common pasture species.
* Low productivity.
* Fair nutritive value, but palatability is rather low.
* Withstands grazing well.

Streambank wheatgrass

Cultivar Notes
Sodar is a U.S. variety used in Canada.

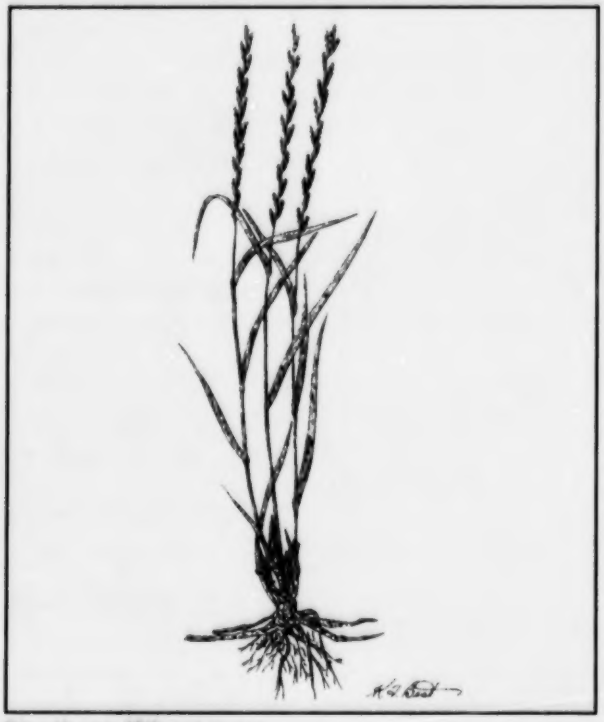
Establishment Notes
* Good seedling vigour, easy to establish.

Management Notes
* Used in reclamation, erosion control and heavy use turf areas.
* Withstands a great deal of trampling and disturbance.

NORTHERN WHEATGRASS

Description
* Long-lived, native grass.

* Sod-forming, but may exhibit a tufted appearance.
* Develops diverse and extensive root system.



Northern Wheatgrass

Adaptation
* Adapted primarily to the Brown and Dark Brown Soil Zones.
* Very drought tolerant.
* Does best on loam and clay loam, but grows well on coarse-textured soils.

Hay
* Lower yield than western wheatgrass.

Pasture
* Highly palatable.
* Nutritive value high, but protein in mature plants is rather low in the fall.
* Moderately tolerant to grazing.
* Deferred grazing is recommended.

Cultivar Notes
* Elbee is a Canadian cultivar originated from southern Alberta and Saskatchewan.

Establishment Notes
* Good seedling vigor, but weed control in the establishment phase is important.
* Stand development is rapid compared to other native grasses.
* Competitive in mixtures.

Management Notes
* Used mainly for reclamation and wildlife.

TALL WHEATGRASS

Description
* Long-lived, perennial grass.
* Tall, coarse, bunch grass with deep root system.
* Bunches expand by developing short rootstocks.

Tall wheatgrass

Adaptation
* Winter hardy.
* Adapted to moist locations in the Brown, Dark Brown and Black Soil Zones.
* Tolerates strong salinity under ***moist to wet*** soil conditions (the most salt tolerant domesticated grass).
* Tolerates spring flooding very well (5 weeks).
* Tolerates alkalinity well under moist soil conditions.
* Sensitive to acidity.
* Tolerates moderate drought but does not persist well in dry soils.

Hay
* Latest maturing wheatgrass.
* Produces fair-quality hay.
* Palatable hay is produced if cut before or shortly after heading.
* Easy to harvest due to upright growth.

Pasture
* Do not graze in the year of establishment.
* Relatively low palatability compared to other grasses, difficult to manage in a mixture with more palatable species.
* Retains better quality later in the season than most other wheatgrasses.

Cultivar Notes
* Orbit is the available cultivar.

Establishment Notes
* Large seed, seed at a rate of 12 lb/acre.
* Slow to establish; seedlings are slow to develop and lack the ability to compete (good weed control is recommended).
* Young stands may be sparse and slow to grow, but stand will improve from seed and the increase in the size of individual bunches.

Management Notes
* An average of 6-8" (15-20 cm) stubble should be left at end of grazing season to maintain vigor.
* Useful as a grass barrier for snow management.
* Useful in salinity control.

CREEPING RED FESCUE

Description
* Long-lived, sod-forming grass.
* Sod becomes quite dense with time, but not as aggressive as smooth bromegrass.
* Extensive root system.
* Shad-tolerant turf grass.

Adaptation
* Adapted to the moist areas of the Black and Gray Soil Zones.
* More acid tolerant than timothy.
* Moderately tolerant to spring flooding .
* Poor drought tolerance.
  - Tolerates moderate salinity.

Creeping red fescue

Hay
* Hay yield is low, as the plant is short and hard to cut.
* Responds well to fertilization.

Pasture
* Well suited for pasture.
* Starts growing early in the season.
* Slow growth in mid summer.
* Very palatable to all kinds and classes of livestock, particularly in the spring and fall.
* Dark-green leaves retain nutritive value in the fall and early winter, particularly when fertilized.
* Generally lower production than smooth bromegrass.
* Tolerates grazing and trampling relatively well.

Cultivar Notes
* Boreal is the cultivar recommended in Saskatchewan.

Establishment Notes
* Will grow better on poor soils than either timothy or kentucky bluegrass.

Management Notes
* Good for spring and fall grazing.

* Good for stockpiling for late fall, early winter and early spring, particularly if fertilized.
* Well-developed stands form a dense sod with a relatively firm base capable of supporting livestock in early spring.
* Yields well with legume mixtures.

CREEPING FOXTAIL

Description
* Long-lived, sod-forming grass.
* Spreads rapidly by rhizomes and seed.

Adaptation
* Adapted to wet areas in all soil zones.
* Tolerates flooding well (up to 4 weeks).
* Adapted to peaty soils.
* Poor drought tolerance.
* Moderately tolerant to salinity and alkalinity.
* Moderately tolerant to acidity.

Hay
* Good hay yield.
* Early maturing.
* Good quality if cut soon after heading.

Pasture
* Well suited for pasture.
* Starts growing early in the season.
* Highly palatable before heading.

Cultivar Notes
* Garrison is the available variety.

Establishment Notes
* Seed light and fluffy, coated seed recommended. Adjust seeding rate to account for weight of coating.
* Seed in moist soils during the growing season.
* Dormant-season seeding is recommended if site remains too wet for most of the growing season.
* Seedlings are somewhat week and slow to establish.

Management Notes
* Has the potential to spread by seed and rhizomes, but its spread is restricted to moist and wet areas.

MEADOW FOXTAIL

Description
* Long-lived, sod-forming grass.

Meadow foxtail

Adaptation
* Adapted to wet sites in all soil zones.
* Adapted to peaty (organic) soils.
* Tolerates moderate acidity.
* Does not tolerate drought or salinity.
* Tolerates slight alkalinity.
* Tolerates spring flooding and water-logged soil conditions well.

Hay
* Lower yield than reed canarygrass and timothy.
* Very early maturing.
* Good quality if cut early.

Pasture
* Well suited for pasture.
* Starts growing early in the season and matures early.
* Good nutritive value and palatability unless grazing is delayed.
* Graze early and more than once, if warranted, to maintain quality and palatability.

Cultivar Notes
* Dan and Mountain are the available varieties.

Establishment Notes
* Easy to establish but coated seed should be used. Adjust seeding rate to account for weight of the coating.
* Seedlings can be week and slow to develop.
* Seed in moist soil during the growing season.
* Dormant-season seeding is recommended if site remains wet during most of the growing season.
* Spreads relatively rapidly.

Management Notes
* Has the potential to spread by seed and rhizomes, but its spread is restricted to moist and wet areas.

REED CANARYGRASS

Descriptio* Tall, coarse, long-lived grass.
* Develops thick rhizomes.

Adaptation
* Adapted to wet sites in all soil zones.
* Tolerates spring flooding very well (5-8 weeks).
* Tolerates water-logged soil conditions well.
* Tolerates acidity well.
* Does not tolerate drought.
* Tolerates mild salinity and alkalinity.

Hay
* High yielding grass.
* Good quality if possible to cut early (e.g. at heading).
* Often 2 cuts are possible or regrowth can be grazed.
* Well established stands (older than 2 years) often develop sufficiently strong sod to withstand traffic.

Reed canarygrass

Pasture
* Palatability may be low, particularly with high alkaloid varieties.

Cultivar Notes
* Use low-alkaloid varieties (e.g. Venture, Palaton, Vantage).

Establishment Notes
* Slow to establish.
* Seedlings do not tolerate flooding or competition from weeds.
* Seed in mid summer or wait for a dry year.
* Dormant-season seeding is another option.

Management Notes
* Responds well to nitrogen fertilization.

GREEN NEEDLEGRASS

Description
* Long-lived, native, bunch grass.
* Develops deep root system.
* Produces plenty of basal leaves.

Adaptation
* Moist Brown, Dark Brown and Black soil zones.
* Does best on loamy to clayey soils, but will grow on coarse-textured soils.
* Moderately drought tolerant.
* Particularly suited to well-drained bottomland.
* Tolerates slight salinity.
* Tolerates slight alkalinity.
* Sensitive to acidity.
* Sensitive to water-logged soil conditions.
* Low tolerance to spring flooding.

Hay
* Rarely seeded for hay in Saskatchewan but is used in the U.S.
* Good hay yield and quality.

Pasture
* Not commonly seeded for pasture in Saskatchewan, but is more commonly used in the US.

Green needlgrass

* Excellent nutritive value and digestibility during the growing season and remain relatively good until late in the season.
* Highly palatable, despite the needles.
* Needles are fine and weak and do not appear to cause problems to animals.
* Tolerates moderate grazing.

Cultivar Notes
* Lodorm is a U.S. (N. Dakota) variety with lower seed dormancy than wild stands. In southern Saskatchewan, this variety appears to perform well on deep, heavy textured soils, but becomes yellowish in colour on sandy soil.
* An ecovar is being developed in Manitoba.

Establishment Notes
* High seed dormancy. Seed dormancy can be reduced by: (1) dry storage, (2) moist pre-chilling, (3) mechanical scarification, or (4) treatment with acid.
* Best seedling emergence achieved with a seeding depth of 5/8 -1 1/8" (1.5 - 3 cm).

Management Notes
* The present main use is revegetation and wildlife plantings.
* Leave 3-4" stubble after grazing.
* A minimum carryover of 6" is needed before winter to maintain a healthy stand.
* Deferred grazing is recommended.

TIMOTHY

Description
* Short to medium-lived, bunch grass.
* Shallow rooting plant.

Adaptation
* Adapted to low lying areas in the moist parts of the Black and Gray Soil zones. Also, suited to acidic soils in the Cypress Hills area.
* Moderately good rainfall required for survival.
* Grows well on peaty (organic) soils.
* Tolerates flooding well (about 5 weeks).
* Tolerates acidity well.
* Sensitive to salinity and alkalinity.
* Does not tolerate drought well.
* Does not tolerate competition from weeds and other forage species.

Hay
* Well suited for hay.
* Good quality if cut before bloom stage.
* Higher energy content than many other grasses.
* Highly valued for horses.

Pasture
* Highly palatable grass.
* Does not persist well under grazing.

Cultivar Notes
* Available cultivars include Climax, Champ and Basho. For other cultivars, including mid and late-maturing types, consult the "Timothy Production Handbook".

Establishment notes
* Light seed.
* Remember to seed shallow.

Timothy

* Small amount (e.g. 0.5-1.0 lb/acre) of timothy can be included in pasture mixtures the in north to provide production from the low-lying areas.
* Grows well in mixtures with legumes.

Management Notes
* Responds well to nitrogen fertilization.
* Competes well with Canada bluegrass on acid soils in the Cypress Hills area.

PERENNIAL RYEGRASS

Description
* Short-lived (about three years), perennial, bunch grass.
* Develops a shallow, fibrous root system.

Adaptation
* Requires an average of at least 20" (500 mm) of annual precipitation, thus it is of no or little value in Saskatchewan, except under irrigation.
* Not winter hardy.
* Sensitive to drought and high temperature.

TALL FESCUE

Description
* Medium to short-lived, sod forming grass.

Gray Soil Zones.

* Winter hardiness is low.
* Tolerates acidity.
* Tolerates spring flooding relatively well.
* Tolerates moderate salinity and alkalinity.
* Does not tolerate drought. Gray Soil Zones.
* Winter hardiness is low.
* Tolerates acidity.
* Tolerates spring flooding relatively well.
* Tolerates moderate salinity and alkalinity.
* Does not tolerate drought.

Hay
* Not considered a primary hay species.

Pasture
* Well suited for pasture.
* Tolerates grazing well.
* Toxicity to horses has been reported.

Cultivar Notes
* Courtney is the available variety.

Establishment
* Slow to establish.

Adaptation
* Best adapted to the moist areas of the Black and

Tall fescue

ORCHARD GRASS

Description
* Short to medium-lived, perennial, bunch grass.

Orchard grass

Adaptation
* Requires fertile soils with average annual precipitation of 18" or greater.
* Winter hardiness is low.
* Moderately tolerant to acidity.
* Does best on medium-textured soils.
* Poor tolerance to flooding, drought, salinity and alkalinity.

Hay
* Can be used for hay production.
* Mixes well with alfalfa.

Pasture
* Highly palatable.
* Good regrowth characteristics under good soil moisture and fertility conditions.
* Somewhat sensitive to grazing.

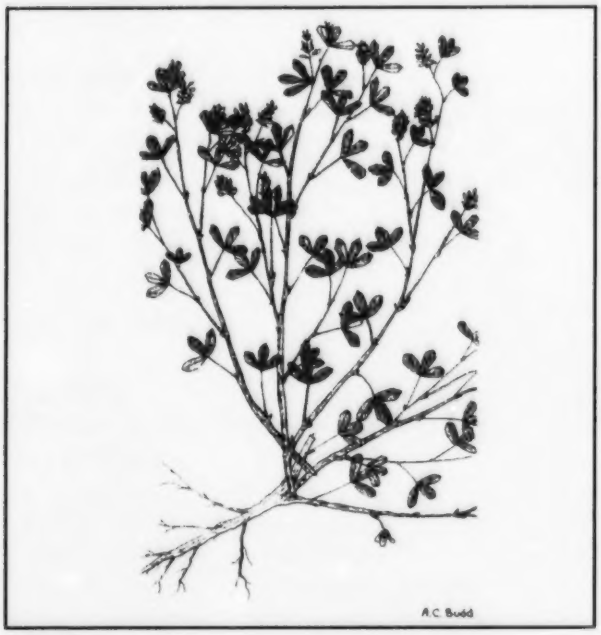
Cultivar Notes
* Available varieties to consider include Kay, AC Nordic and Arctic.

Management Notes
* Close continuous grazing will result in greater degree of winter kill.
* Leave sufficient stubble (average 5-6") after grazing.
* Leave a carryover of about 8" for over-wintering.
* Responds well to nitrogen fertilization.
* High stocking density is required in spring to prevent formation of unpalatable clumps.

ALFALFA

Description

* Broad-leaved, perennial legume.
* Medium to long-lived perennial legume
* Usually classified into two broad types: tap-rooted and creeping-rooted types.
* Creeping-rooted type is generally more persistent and tolerate adverse conditions (drought, grazing, winter severity and disease.)



Alfalfa

Adaptation

* The ability of the root system to obtain moisture and nutrients from deep in the soil makes alfalfa a specially useful forage crop during periods of drought.
* Adapted to a variety of soil and climatic conditions but performs best on deep, loamy soils with high lime content.
* Tolerates slight alkalinity.
* Sensitive to acidity below pH of 6.0.
* Tolerates moderate salinity.
* Intolerant to flooding, waterlogging or poor internal drainage during the growing season (well-drained soils are required).
* Tolerates spring flooding for only two weeks before growth starts in the spring.

Hay

* The preferred hay crop in Saskatchewan.
* High forage yield.
* High quality forage.
* Easy to harvest.
* The most persistent varieties have the lowest regrowth potential.
* If managed properly will give the highest combination of forage quantity and quality.
* Cutting in late August or September may cause winter injury, winter kill or substantial reduction in yield.

Pasture

* Bloat hazard. Careful management practices and precautions are required.
* High quality pasture for all classes of livestock.
* Greater capacity and persistence than most other legumes.
* Including a palatable grass or sainfoin will reduce bloat risk.
* Bloat risk decreases if grazing is delayed till bloom stage.
* Palatable to all classes of livestock.
* Excellent animal weight gains.

Cultivar Notes

* Creeping-rooted cultivars (Heinrichs, Rangelander, Roamer, Rambler) withstand grazing pressure, and drought better than the tap-rooted cultivars.
* The tap-rooted cultivars (e.g. Beaver, Algonquin, Apica) are generally more productive than the creeping-rooted cultivars and are recommended for hay.
* AC Grazeland, a reduced-bloat cultivar, will be released in the year 2000.
* Research is underway to introduce a tannin gene into alfalfa leaves to reduce bloat incidence.

Establishment Notes

* Recommended seeding rates often produce more alfalfa plants in normal years than many producers tolerate in their pastures.

Management Notes

* Increases productive capacity of grass pastures.
* Including about 20% sainfoin in alfalfa stand appears to substantially reduce the incidence of bloat.
* Should not be grazed closer than 10-15 cm to maintain vigor and, possibly, allow for self - seeding.
* Dormant grazing is possible, but good stubble height will help trap snow to insulate against low winter temperatures and frost heaving and provide moisture in the spring.
* Plants are sensitive to depletion of carbohydrates in the roots. Repeat defoliations should only occur after plants reach a height of 25 cm, or the bud stage, to accumulate enough reserves to be vigorous.
* As a rule of thumb, alfalfa should not be cut during the 4-6 week period before the average date of the first killing frost so that little or no regrowth takes place, allowing the plants to begin the winter with adequate carbohydrates. This is estimated to be:
    - North: Early August to mid September
    - central: August to mid September
    - South: late August to early October
* Winter kill appears to be caused by one or a combination of the following:
    - low food reserves
    - ice encasement
    - soil heaving
    - diseases
    - poor soil fertility.

SAINFOIN

Description

* Short to medium-lived legume.
* Develops deep, branched tap root.

Adaptation

* Less hardy than alfalfa.
* Suited to the Dark Brown Soil Zone and moist areas of the Brown Soil Zone.
* Areas with average annual precipitation of 12" (300 mm) or greater.
* Optimum growth on deep, well drained soils with good moisture holding capacity.
* Adapted to dry calcareous soils.
* Does well on thin, gravelly soils.
* Grows well in soils low in phosphorus compared to other legumes.
* Tolerates drought but growth reduced.
* Sensitive to salinity, spring flooding and water-logged soil conditions.
* Does not tolerate much acidity.
* Tolerant to high alkalinity.

Hay

* Yield approaches that of alfalfa in areas where alfalfa produces one cut (80-85%.)
* Upright growth makes it easy to harvest for hay.
* Crude protein is lower than alfalfa, but digestibility is similar.
* Cattle performance on sainfoin hay is similar to that on alfalfa.
* Starts blooming 2 weeks earlier than alfalfa.

Sainfoin

* Cut at the 50-100% bloom stage (encourages regrowth) for the best tonnage and nutrient yield.
* Regrowth after cutting is slower and lower in amount than alfalfa.
* Shorter-lived than alfalfa (winter killing, drought or competition from grass.)

Pasture
* Starts growing earlier than alfalfa.
* High proportion of its growth takes place in the spring.
* Bloat-safe (tannins).
* Palatable.
* Good animal gains.
* Leaves are retained longer than alfalfa and can be harvested at a more advanced stage of maturity without appreciable loss of quality.
* Sheep prefer sainfoin over alfalfa.

Establishment Notes
* Excellent seedling vigor, but avoid using a companion crop.
* Can be seeded alone or in a mix with bunch grasses such as meadow brome or crested wheatgrass. Avoid aggressive rhizomatous species such as smooth brome.
* Stands persists better in alternate rows with grasses.
* Seeding rate is very high due to the large seed size. Seed pure stand at 20-30 lb/acre. Reduce by one third if seeding in a mixture with grass.
* Seeding depth 1-2 cm.
* Grazing in the seeding year will reduce the vigor.

Management Notes
* N fertilization may be necessary. Nodulation is not always successful with present inoculation technology.
* Not as effective as alfalfa in competing against certain perennial weeds like Canada thistle.
* Heavy utilization of grass will help maintain sainfoin longer.
* Regrowth is better when cut in the bud or early bloom stage than when cut at more mature stages. (Total yield is highest, however, when the first crop is cut late.)
* Close continuous grazing will result in stand losses.
* Good stands persist for 3-5 years. Some producers reported well-rested stands grazed for more than 10 years in the Dark Brown Soil Zone.
* Recovers more slowly after grazing than alfalfa. Regrowth is also lower.
* Stand persistence is improved by light to medium grazing intensity at the bud or early flower stage, leaving 8" (20 cm) stubble.
* Graze in the bud or early bloom stage to encourage regrowth.

Cultivar Notes
* Nova is the available Canadian cultivar.

CICER MILKVETCH

Description
* Potentially long-lived perennial legume.
* Spreads by extensive rhizomes.
* Good soil erosion control.

Cicer milkvetch

Adaptation
* Best adapted to the Dark Brown and Black Soil Zones, particularly in areas with average annual precipitation of at least 16" (400 mm). May be tried in the moist areas of the Brown Soil Zone.
* Adapted to wide variety of soil textures, but shows the creeping habit on moderately coarse to coarse-texture soils.

* Tolerates moderate drought.
* Tolerates moderate salinity.
* Tolerates moderate alkalinity.
* Tolerates slight acidity.
* Adapted to sub-irrigated sites.
* Low tolerance to spring flooding.
* Appears to be less attractive to pocket gopher than alfalfa.

Hay
* Becomes decumbent to trailing late in the season.
* Leaf retention during cutting and handling is better than alfalfa.
* Produces about 75% of alfalfa=s yield.

Pasture
* Bloat safe.
* Established stands start growing about 3 weeks later in the spring than alfalfa, continue growing and stays green longer in the fall.
* Good pasture in pure stands or in grass mixtures.
* Does not accumulate selenium as do some of the native milkvetches.
* Nutritive value and palatability are similar to those of alfalfa.
* Retains its nutritive value in late fall better than alfalfa.
* Tolerates grazing well.
* Recovers more slowly after grazing or cutting than alfalfa.
* One study from US indicated possible photosensitization of ruminant grazing cicer milkvetch. No reported cases from Canada, however.

Establishment Notes
* Difficult to establish due to low seedling vigor and slow emergence.
* Seeds have hard seed coat. Seeds need scarification.
* Well-prepared seed-bed is essential.
* Do not plant a companion crop.
* Best seeded in the spring, seed at a depth 2 to 3/4".
* Black Soils: row spacing 6-7 A and seeding rate of 10-12 lb/acre; Dak Brown Soils: row spacing 12-18" and seeding rate of 6-8 lb/acre.

Management Notes
* High competitive ability once established.

Cultivar Notes
* Oxley is the presently available cultivar. A new variety with improved yield and establishment is to be released in the year 2000.

RED CLOVER

Description
* Short-lived perennial legume (good stand lasts 2-3 years.)
* Develop tap root with many side branches but is not as deep as alfalfa.
* Single and double cut types available.

Adaptation
* Best adapted to the moist areas of the Black and Gray Soil Zones (use single-cut types).
* Tolerates acidity (pH 5.0-6.0) more than alfalfa, alsike clover and sweetclover.
* Does not tolerate lengthy drought.
* Does not tolerate salinity.
* Less tolerant to poorly drained soils than alsike clover.
* Tolerates only two weeks of spring flooding.

Hay
* Yield 75-80% of alfalfa.
* Cut for hay at 10% bloom for best quality hay and to allow for regrowth of a second cut.
* Difficult to dry because of high moisture content.
* A crimper or conditioner will hasten drying.
* Grows well with timothy.

Pasture
* Risk of bloat.
* Satisfactory in mixtures, but short-lived.
* Regrowth after haying can be grazed.

Establishment notes
* Seeding rate for hay 7 lb/acre alone, 4 lb/acre in grass mix.
* Seeding rate for pasture 2 lb/acre in grass mix.
* If using a companion crop seed at half normal rate in alternate or cross rows and remove early for silage.

Management Notes
* Should not be grazed the first year.

Cultivar Notes
Altaswede and Norlac are the cultivars recommended in Saskatchewan. Both cultivars are of the single-cut type and are considered the hardiest.

ALSIKE CLOVER

Description
* Short-lived perennial legumes with fine stems.
* Deep branching but not creeping roots.
* Useful for short rotation to improve soil structure and fertility.

Adaptation
* Adapted to cool wet soils in the Gray Soil Zone.
* Tolerates acidity.
* Does best on loamy to clayey soils.
* Tolerates up to 6 weeks of spring flooding.
* Tolerates poor drainage (water-logged soils) relatively well.
* Tolerates alkalinity more than the other perennial legumes.
* Winter hardy.
* Do not tolerate drought or high temperatures.
* Performs better than red clover under poor-fertility soils.

Hay
* Cut at the full bloom stage.
* Difficult to cure in the field due to site wetness.
* Susceptible to lodging during hay production due to the fine stems.
* Can be mixed with reed canarygrass or timothy to hold it up and make easier to harvest.
* Only one cut is possible.

Pasture
* Risk of bloat.
* Palatable.
* Good regrowth after grazing, but short-lived.
* It may dominate in a mixture for a couple of years, then declines.

Cultivar Notes
* Diploid is the common type (such as Aurora and Dawn) and is considered hardier than the Tetraploid.

Establishment Notes
* Can be established in ash when seeded by plane after forest fires.
* Do not use a companion crop (if necessary to control erosion, use oats or barley seeded at 2 the usual crop rate and remove early for silage or greenfeed.)
* Do not cut or graze in the year of seeding.

WHITE CLOVER

Description
* The wild type is long-lived, all other types (Ladino, Dutch) are short lived (2-3 years).
* Shallow tap root and small crown.
* Spreads by stolons (above ground stems that root at the nodes.)
* No main upright stems.

Adaptation
* Wild type persists but the other types have low to moderate winter hardiness.
* Best adapted to silty loam and clayey soils that have good and fairly constant supply of moisture (e.g. irrigated areas).
* Tolerates slight acidity.
* Does not tolerate saline or alkaline soils.
* Sensitive to drought and high temperatures.
* Intolerant of prolonged spring flooding.
* Intolerant to water-logged soils.

Hay
* Only the tall Ladino type is suited for hay but lacks winter hardiness.
* High quality forage.

Pasture
* Risk of bloat.
* Palatable.
* High nutritive value.
* Begins growth early.
* The wild type withstands considerable close and continuous grazing, but yield is reduced under those conditions.
* Rapid regrowth after grazing.

Establishment Notes
* Hard seed coat. Use scarified seed.

Cultivar Notes
* Growth form varies: Ladino is tall, Dutch is mostly intermediate and wild type is low growing.

SWEETCLOVER

Description
* Fast-growing biennial legume. In the seeding year it produces a plant with a single well-branched stem. In the second year, several coarse, vigorous stems develop from the crown. Seed is produced in the second year.
* Develops a deep tap root.
* Well recognized for its soil improvement properties.

Adaptation
* Adapted to the Brown, Dark Brown and Black Soil Zones.
* Does well on soil textures ranging from sandy to clayey, but best performance is noted on intermediate textures.
* Winter hardy.
* Tolerates moderate salinity.
* Tolerant to high alkalinity.
* Tolerant to drought.
* Sensitive to acidity (as is alfalfa).
* Sensitive to waterlogged soil conditions.
* Tolerates only a few days of spring flooding.

Sweetclover

Hay
* High yield but difficult to harvest.
* Quality high if cut at bud stage, and low if cut at full bloom.
* Contains coumarin which develop into dicoumarol, an anticoagulant, under poor curing. conditions. It is desirable to use low coumarin varieties, test for coumarin or dilute or alternate feeding with other forages. (Dicoumarol reduces the blood-clotting ability of the animals consuming the forage.)
* Improperly cured or moldy hay should be used with caution.
* A stubble of 30 cm is necessary for regrowth.

Pasture
* Risk of bloat (somewhat lower than alfalfa and true clovers).
* Young stages of growth provide palatable, nutritious forage.
* It may contain high levels Coumarin, an aromatic compound, which can affect the palatability until the animals get used to the bitter taste.
* Maintain a stubble height of 30 cm during the season to allow for regrowth.

* Regrowth after hay can be grazed.
* Scouring may occur specially when growth is young and succulent.

Cultivar Notes
* Two types: white and yellow flowered. The white type (e.g. Polara) is taller with coarser stems and leaves. The yellow type (e.g. Norgold) is more drought tolerant, has greater seedling vigor, flowers earlier and has a more spreading growth. Both Polara and Norgold are low-coumarin cultivars.

Establishment Notes
* Hard seed coat. Use scarified seed.
* Use low-coumarin varieties.

BIRDSFOOT TREFOIL

Description
* Short to medium-lived perennial legume.
* Tap root with numerous lateral branches, but does not root as deep as alfalfa.

Birdsfoot trefoil

Adaptation
* Best suited to moist areas in the Black and Gray Wooded soil zones.
* Low winter hardiness, even with adapted varieties.
* Tolerant to water-logging.
* Tolerates several weeks of spring flooding (better than alfalfa).
* Good tolerance to acidity.
* May be useful in some organic soils.
* Good tolerance to alkalinity.
* Tolerates mild salinity.
* Poor drought tolerance.
* Does well on soils ranging from sandy loam to clayey.
* Optimum productivity on fertile, moderately to well drained soils with pH 6.2-6.5.

Hay
* One cut only.
* Yield 3/4 of that of alfalfa.
* Higher water content than alfalfa which makes it more difficult to dry.
* Hay quality is comparable to alfalfa.
* Heavy crop lodges, making it difficult to cut.

Pasture
* Withstand grazing relatively well.
* Bloat safe (tannins precipitate the soluble proteins, preventing them from producing stable foam in the rumen.)
* Highly palatable to cattle and sheep, but apparently of low palatability to horses.
* Production is distributed throughout the growing season.
* Regrowth after haying can be grazed, but reserve replenishment should be allowed.

Cultivar Notes
* The empire type is the most common and most winter hardy.
* Cree and Leo are the recommended cultivars for Saskatchewan.

Management Notes
* Stand persistence is a major problem. Usually no more than 2-4 years. Rotational grazing and good snow cover help with persistence.

* Like alfalfa, is subject to depletion of food reserves in fall, which aggravates the lack of winter hardiness.
* Intolerant to competition from grasses. Best grown alone, but use meadow bromegrass or timothy if needed.

FURTHER READINGS AND REFERENCES

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SPECIES GROUPS

Forage species can be classified into groups based on their origin (native versus tame or introduced) or their general botanical (taxonomic) characteristics (grasses versus legumes; or grass groups like bromegrasses, wheatgrasses, fescues). Here are some of the main groups with a cross reference to their page number in this publication:

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* Largely according to Budd's Flora & Looman (1983).

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